PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-172586

(43)Date of publication of application : 26.06.1998

(51)Int.Cl. H01M 8/02
H01M 8/04
H01M 8/10

(21)Application number : 08-323135

(22)Date of filing : 03.12.1996

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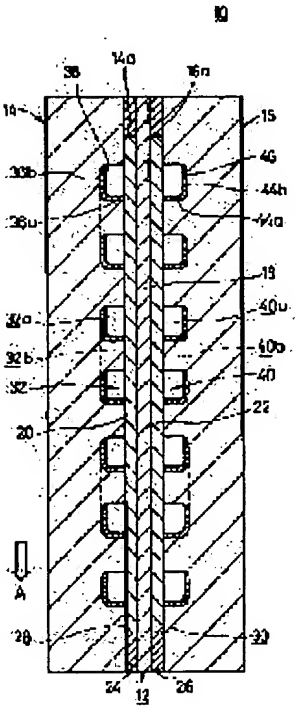
(54) FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To surely absorb and remove moisture in a gas flow path to obstruct the plugging of the gas flow path, and provide a fuel cell with high gas diffusion capability and high performance by arranging a water absorbing member for varying the cross section area of the flow path according to the water absorption amount in a part of a first flow path for supplying fuel gas and/or a second flow path for supplying oxidizing gas.

SOLUTION: A fuel cell 10 has a cell 12 and first and second separators 14, 16. A first flow path 32 for supplying hydrogen of fuel gas is formed in an anode side electrode 20. A high water absorbing polymer sheet 38 which varies a flow path cross section area according to the water absorption amount is integrally fixed to the bottom 36a and the side surface 36b for forming a horizontal part 32a of the flow path 32. A second flow path 40 for supplying air which is an oxidizing agent gas to a cathode side electrode 22 is formed on the surface 16a of the separator 40.



LEGAL STATUS

[Date of request for examination] 26.11.2002

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CLAIMS

[Claim(s)]
[Claim 1] The fuel cell structure which consists of an anode lateral electrode and a cathode lateral electrode on both sides of the solid-state polyelectrolyte film, It has the 1st and 2nd separators which pinch said fuel cell structure. Said 1st separator While having the 1st passage which supplies fuel gas to said anode lateral electrode, said 2nd separator The fuel cell characterized by having the 2nd passage which supplies oxidant gas to said cathode lateral electrode, and arranging in a part of said the 1st and/or 2nd passage the water absorption member to which the passage cross section is changed according to a coefficient of water absorption.
[Claim 2] It is the fuel cell characterized by having the wedge configuration which projects in said fuel cell structure side in order that said water absorption member may change partially the rate of flow of said fuel gas and oxidant gas in a fuel cell according to claim 1.
[Claim 3] The fuel cell characterized by preparing the obstructive section for projecting to said fuel cell structure side, and changing partially the rate of flow of said fuel gas and oxidant gas in said 1st and 2nd passage in a fuel cell according to claim 1.
[Claim 4] It is the fuel cell characterized by the opening cross section of the part to which said 1st and 2nd passage crosses in the gravity direction in a fuel cell according to claim 1 differing from the opening cross section of the part which goes in the gravity direction.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell which consisted of an anode lateral electrode and a cathode lateral electrode on both sides of the solid-state polyelectrolyte film.
[0002]
[Description of the Prior Art] The polymer electrolyte fuel cell is constituted by pinching with a separator the fuel cell structure (unit cell) which consists of the anode lateral electrode and cathode lateral electrode which are arranged at the both sides of the electrolyte which consists of macromolecule ion exchange membrane (cation exchange membrane), and this electrolyte, respectively.
[0003] In this kind of fuel cell, on a catalyst electrode, the fuel gas supplied to the anode lateral electrode, for example, hydrogen, is hydrogen-ion-ized, and it moves to a cathode lateral electrode side through the electrolyte humidified moderately. The electron produced in the meantime is taken out by the external circuit, and is used as electrical energy of a direct current. Since oxidant gas, for example, oxygen gas, or air is supplied, in this cathode lateral electrode, said hydrogen ion, said electron, and oxygen react, and water is generated by the cathode lateral electrode.
[0004] By the way, in order to hold ionic permeability, it is necessary to make the electrolyte which consists of macromolecule ion exchange membrane fully humidify. For this reason, by humidifying oxidant gas and fuel gas generally using the gas humidification equipment formed in the exterior of a fuel cell, and sending to a fuel cell by making these into a steam, it is constituted so that an electrolyte may be humidified.
[0005]
[Problem(s) to be Solved by the Invention] However, the moisture with which the polymer electrolyte fuel cell was generated by the moisture which was not absorbed by the electrolyte in the moisture supplied to humidification since operating temperature was low temperature (- 100 degrees C) comparatively, and the reaction may exist in the state of a liquid(water). This water is accumulated in a gaseous diffusion layer, and blockades a gas passageway, the diffusibility to the fuel gas which is reactant gas, and the electrode catalyst bed of oxidant gas falls, and the problem that the cel engine performance gets remarkably bad is pointed out.
[0006] Then, it extends in the gravity direction, the parallel slot for fuel gas supply and the slot for oxidant gas supply of each other are established in both sides of a separator, and the fuel cell constituted so that fuel gas and oxidant gas might be automatically discharged by the lower part of the gravity direction in said Mizouchi is known as indicated by JP,6-20713,A. However, with the above-mentioned conventional technique, since fuel gas and oxidant gas are discharged in the gravity direction, there is a problem that especially the utilization factor of fuel gas falls and the engine performance of the fuel cell itself worsens.
[0007] This invention solves this kind of problem, and it aims at moreover offering the highly efficient fuel cell excellent in gaseous diffusion nature while it prevents that carry out water absorption removal of the moisture in a gas passageway certainly, and said gas passageway is blockaded.

[0008]
[Means for Solving the Problem] In order to solve the aforementioned technical problem, while this invention has the 1st passage where the 1st separator supplies fuel gas to an anode lateral electrode, it has the 2nd passage where the 2nd separator supplies oxidant gas to a cathode lateral electrode, and the water absorption member to which each passage cross section is changed according to a coefficient of water absorption is arranged in a part of said the 1st and/or 2nd passage. Therefore, since the water of condensation and produced water of moisture which are contained in fuel gas or oxidant gas are absorbed by the water absorption member, they can prevent certainly that the 1st and/or the 2nd passage are blockaded bywater.
[0009] And when a water absorption member swells and dries, the passage cross section of the 1st and 2nd passage is changed. For this reason, while becoming possible for a gas flow rate to change in the 1st and 2nd passage, for example, to make said gas flow rate increase, and to raise the gaseous diffusion nature to an electrode catalyst bed, said gas flow rate can be decreased partially and gaseous diffusion nature can be made to equalize on the whole.
[0010] Moreover, the obstructive section which has the wedge configuration to which a water absorption member projects in a fuel cell structure side in order to change partially the rate of flow of fuel gas and oxidant gas, or has the same function in the 1st and 2nd passage is prepared. Therefore, the rate of flow goes up in the 1st and 2nd passage, gas pressure increases, and the gaseous diffusion nature to an electrode catalyst bed improves effectively.
[0011] The opening cross section of the part to which the 1st and 2nd passage crosses in the gravity direction differs from the opening cross section of the part which goes in the gravity direction further again. If the opening cross section of the part which crosses for example, in the gravity direction is set up by this smaller than the opening cross section of the part which goes in the gravity direction, gas pressure will rise in the part which crosses in this gravity direction.
[0012]
[Embodiment of the Invention] Drawing 1 is the outline longitudinal-section explanatory view of the fuel cell 10 concerning the 1st operation gestalt of this invention.
[0013] A fuel cell 10 is equipped with the fuel cell cel (fuel cell structure) 12 and the 1st and 2nd separators 14 and 16 which pinch this fuel cell cel 12, and the laminating of two or more sets of these is carried out if needed. The fuel cell cel 12 has the solid-state polyelectrolyte film 18, and the anode lateral electrode 20 and the cathode lateral electrode 22 arranged on both sides of this electrolyte membrane 18.
[0014] On both sides of the fuel cell cel 12, the 1st and 2nd gaskets 24 and 26 are formed, and while said 1st gasket 24 has the big opening 28 for containing the anode lateral electrode 20, it has the big opening 30 for said 2nd gasket 26 to contain the cathode lateral electrode 22. The fuel cell cel 12 and the 1st and 2nd gaskets 24 and 26 are pinched with the 1st and 2nd separators 14 and 16. The 1st passage 32 for supplying the hydrogen which is fuel gas to the anode lateral electrode 20 is formed in field 14a of the 1st separator 14. As shown in drawing 2 , the 1st passage 32 is open for free passage to fuel gas exhaust port 34b prepared in the lower part side of said 1st separator 14 while it is open for free passage to fuel gas feed hopper 34a prepared in the upper part side of the 1st separator 14.
[0015] The 1st passage 32 has partial (henceforth part for horizontal level) 32a which extends to horizontally (the direction of arrow-head B) it crosses in the gravity direction (the direction of arrow-head A), and partial (henceforth vertical part) 32b which extends in said gravity direction. As shown in drawing 1 , the high absorptivity polymer sheet (water absorption member) 38 to which the passage cross section of said 1st passage 32 is changed according to a coefficient of water absorption is fixed to base 36a and side-face 36b which form horizontal level part 32a of the 1st passage 32 in one.
[0016] The high absorptivity polymer sheet 38 is formed so much by the fuel gas exhaust port 34b side rather than the fuel gas feed hopper 34a side, and it is set up so that expansion of the downstream of the 1st passage 32 may become large compared with expansion of the upstream. The high absorptivity polymer sheet 38 is formed only in horizontal level part 32a, and as shown in drawing 4 and drawing 5 , the depth d1 of this horizontal level part 32a and the depth d2 of vertical partial 32b have the relation of

d1<d2.
[0017] Water-repellent treatment is given to said vertical partial 32b, and, specifically, coating of the ingredient which has water repellence in vertical partial 32b, for example, the polytetrafluoroethylene, (PTFE) is carried out to it.
[0018] The 2nd passage 40 for supplying the air (or O2) which is oxidant gas to the cathode lateral electrode 22 is formed in field 16a of the 2nd separator 16. As shown in drawing 3 , the 2nd passage 40 is open for free passage to oxidant gas exhaust port 42b prepared in the lower part side of said 2nd separator 16 while it is open for free passage to oxidant gas feed hopper 42a prepared in the upper part side of the 2nd separator 16.
[0019] The 2nd passage 40 has partial (henceforth part for horizontal level) 40a which extends in the direction which crosses in the gravity direction, and partial (henceforth vertical part) 40b which extends in said gravity direction. As shown in drawing 1 , the high absorptivity polymer sheet (water absorption member) 46 to which the passage cross section of said 2nd passage 40 is changed according to a coefficient of water absorption is fixed to base 44a and side-face 44b which form horizontal level part 40a of the 2nd passage 40 in one. The high absorptivity polymer sheet 46 is set up so much more than the high absorptivity polymer sheet 38 prepared in the 1st passage 32 as a whole while being prepared so much more [in the oxidant gas exhaust port 42b side] than the oxidant gas feed hopper 42a side.
[0020] Thus, actuation of the fuel cell 10 constituted is explained below.
[0021] While hydrogen (fuel gas) is supplied to the 1st passage 32 from fuel gas feed hopper 34a prepared in the upper part side of the 1st separator 14, air (oxidant gas) is supplied to the 2nd passage 40 from oxidant gas feed hopper 42a prepared in the upper part side of the 2nd separator 16. The hydrogen supplied to the 1st passage 32 moves caudad so that it may move in a zigzag direction in the weight direction through horizontal level part 32a and vertical partial 32b, and it is supplied to the anode lateral electrode 20 of the fuel cell cel 12. On the other hand, the air supplied to the 2nd passage 40 moves caudad, moving in a zigzag direction in the weight direction through horizontal level part 40a and vertical partial 40b similarly, and is supplied to the cathode lateral electrode 22 which constitutes the fuel cell cel 12.
[0022] Here, the steam for electrolyte humidification is contained beforehand, the hydrogen supplied to the 1st passage 32 has some which condense without being absorbed by the electrolyte membrane 18 and exist in the state of water in this steam, and this water tends to remain in said 1st passage 32.
[0023] However, with the 1st operation gestalt, as shown in drawing 1 , the high absorptivity polymer sheet 38 from which the passage cross section of said 1st passage 32 is changed to base 36a and side-face 36b of horizontal level part 32a which constitute the 1st passage 32 according to a coefficient of water absorption is being fixed in one. For this reason, the water generated within horizontal level part 32a is certainly absorbed by the high absorptivity polymer sheet 38, and can prevent that the 1st passage 32 is blockaded bywater.
[0024] Furthermore, if the high absorptivity polymer sheet 38 absorbs water, as shown in drawing 6 , this high absorptivity polymer sheet 38 very thing will swell, and the volume will increase. Therefore, the passage cross section of horizontal level part 32a decreases, the gas flow rate in this horizontal level part 32a becomes quick, and the effectiveness that the diffusibility to the anode lateral electrode 20 of the hydrogen which is fuel gas improves effectively is acquired.
[0025] And since the high absorptivity polymer sheet 38 is formed so much more [in the fuel gas exhaust port 34b side] than the fuel gas feed hopper 34a side, compared with the upstream, it swells greatly in the downstream of the 1st passage 32, and the passage cross section of this downstream decreases. In the downstream of the 1st passage 32 where the amount of hydrogen supplied tends to decrease by this, gaseous diffusion nature can be raised effectively and advanced features of the fuel cell 10 whole are carried out easily.
[0026] Moreover, if the high absorptivity polymer sheet 38 dries, the volume will decrease, the passage cross section of horizontal level part 32a will be expanded, and a gas flow rate will become slow. Therefore, by setting an amount, a rate of the maximum swelling, etc. of the high absorptivity polymer sheet 38 as arbitration, according to the humidity condition of hydrogen, the passage cross section of

horizontal level part 32a can be set up automatically, and it becomes possible to obtain desired gaseous diffusion nature with high precision.

[0027] In addition, although the 1st passage 32 is supplied from fuel gas feed hopper 34a in the condition of having been humidified beforehand, in case it is sent to the fuel gas exhaust port 34b side which is the downstream, it is easy to dry hydrogen. Then, it becomes possible by including water in the high absorptivity polymer sheet 38 beforehand to supply certainly said hydrogen which could humidify in hydrogen and was humidified from this high absorptivity polymer sheet 38 also to the downstream of the 1st passage 32.

[0028] Horizontal level part 32a consists of vertical partial 32b shallowly by forming the high absorptivity polymer sheet 38 in the 1st passage 32 further again. For this reason, the gas pressure in horizontal level part 32a rises, and the advantage that gaseous diffusion nature improves further is acquired.

[0029] On the other hand, in the 2nd passage 40 to which air is supplied, condensation of the steam contained in this air and the water containing produced water are generated. The high absorptivity polymer sheet 46 is being fixed to horizontal level part 40a which constitutes the 2nd passage 40 in one in that case. Therefore, the water generated within horizontal level part 32a is certainly absorbed by the high absorptivity polymer sheet 46, and the same effectiveness as the above-mentioned 1st passage 32 side is acquired in the 2nd passage 40.

[0030] And in the 2nd passage 40, in order to supply air as oxidant gas and only for a desired amount to supply the oxygen in this air to the cathode lateral electrode 22, it is necessary to raise a gas flow rate rather than the 1st passage 32 side. Moreover, since the water containing produced water exists in the 2nd passage 40, it is necessary to process a lot of water than the 1st passage 32 side. So, with the 1st operation gestalt, the gas flow rate in this 2nd passage 40 and improvement in a coefficient of water absorption can be aimed at by setting up the high absorptivity polymer sheet 46 prepared in the 2nd passage 40 so much more than the high absorptivity polymer sheet 38 prepared in the 1st passage 32 as a whole.

[0031] Drawing 7 is the outline longitudinal-section explanatory view of the fuel cell 60 concerning the 2nd operation gestalt of this invention. In addition, the same reference mark is given to the same component as the fuel cell 10 concerning the 1st operation gestalt, and the detailed explanation is omitted.

[0032] A fuel cell 60 is equipped with the 1st and 2nd separators 62 and 64, and the obstructive sections 66 and 68 for projecting to the fuel cell cel 12 side, and changing the rate of flow of hydrogen and air partially are formed in the 1st and 2nd passage 32 and 40 of these 1st and 2nd separators 62 and 64.

[0033] As shown in drawing 8 , the obstructive sections 66 and 68 have the shape of an abbreviation wedge equipped with the inclined plane 70 which inclines in the fuel cell cel 12 side toward the flow direction (the direction of arrow-head C) of hydrogen and air, and the vertical plane 72 which extends in the direction which intersects perpendicularly in said direction of arrow-head C from the tip of this inclined plane 70. The inclined plane 70 of the obstructive sections 66 and 68 is covered in the 1st and 2nd passage 32 and 40 at least, and the high absorptivity polymer sheets 74 and 76 are fixed to it.

[0034] Thus, in the fuel cell 60 constituted, while the hydrogen supplied to the 1st passage 32 of the 1st separator 62 moves in the direction of arrow-head C among drawing 8 , the part moves along the inclined plane 70 of the obstructive section 66. For this reason, the rate of flow of hydrogen goes up partially in the 1st passage 32, the increment in gas pressure is caused, and the effectiveness that the diffusibility to the anode lateral electrode 20 of hydrogen improves effectively is acquired.

[0035] On the other hand, the part moves the air supplied to the 2nd passage 40 of the 2nd separator 64 along the inclined plane 70 of the obstructive section 68 while it flows in the direction of arrow-head C among drawing 8 similarly, and the increment in gas pressure is caused.

[0036] It becomes possible for gaseous diffusion nature to improve and to maintain the fuel cell cel 12 to high performance by this, only by forming the obstructive sections 66 and 68 in the 1st and 2nd passage 32 and 40. In addition, the obstructive sections 66 and 68 may be replaced with what is directly formed in the 1st and 2nd separators 62 and 64, and may constitute the obstructive sections 66 and 68 by

fixing a wedge-like member to these 1st and 2nd separators 62 and 64.
[0037] Moreover, as shown in drawing 9 , the high absorptivity polymer sheets 74a and 76a which deform in the shape of [desired] a wedge can also be formed in the 1st and 2nd passage 32 and 40 by absorbing water and swelling.
[0038] Drawing 10 is the outline longitudinal-section explanatory view of the fuel cell 80 concerning the 3rd operation gestalt of this invention. In addition, the same reference mark is given to the same component as the fuel cell 10 concerning the 1st operation gestalt, and the detailed explanation is omitted.
[0039] A fuel cell 80 is equipped with the 1st and 2nd separators 82 and 84, and the 1st and 2nd passage 86 and 88 which branched in the book (4 [for example,]), respectively is formed in the fields 82a and 84a of these 1st and 2nd separators 82 and 84. As shown in drawing 11 , the 1st four passage 86 has branched from fuel gas feed hopper 90a prepared in the upper part side of the 1st separator 82, and this 1st passage 86 is open for free passage in one to fuel gas exhaust port 90b which moved in a zigzag direction in the gravity direction, and was prepared in the lower part side of this 1st separator 82.
[0040] The 1st passage 86 has horizontal level part 87a and vertical partial 87b, and the high absorptivity polymer sheet 92 from which the passage cross section of said 1st passage 86 is changed to this horizontal level part 87a according to a coefficient of water absorption is formed. In addition, the 2nd passage 88 is constituted like the 1st above-mentioned passage 86, and the high absorptivity polymer sheet 94 is formed in the horizontal level part 89a.
[0041] Thus, in the fuel cell 80 constituted, if hydrogen is supplied to the 1st four passage 86 from fuel gas feed hopper 90a prepared in the upper part side of the 1st separator 82, this hydrogen will move caudad so that it may move in a zigzag direction in the weight direction through each horizontal level part 87a and vertical partial 87b, and will be supplied to the anode lateral electrode 20 of the fuel cell cel 12. On the other hand, with the 2nd separator 84, if air is supplied to the 2nd four passage 88, it will move caudad so that this air may move in a zigzag direction in the gravity direction, and the cathode lateral electrode 22 of the fuel cell cel 12 will be supplied.
[0042] Water and produced water which were condensed without being absorbed by the electrolyte membrane 18 can prevent certainly it being absorbed by the high absorptivity polymer sheets 92 and 94, and blockading the 1st and 2nd passage 86 and 88 in that case.
[0043] And in the remarkable part of gaseous diffusion, as produced water becomes abundant, for example, it is shown in a two-dot chain line among drawing 10 , high absorptivity polymer sheet 94a which absorbed a lot of produced water swells greatly compared with other high absorptivity polymer sheets 94. For this reason, it becomes smaller than the passage cross section of other 2nd passage 88 where the passage cross section of 2nd passage 88a in which high absorptivity polymer sheet 94a was arranged branched. Therefore, high absorptivity polymer sheet 94a is resisting, the gas flow rate of 2nd passage 88a becomes slow, and the gaseous diffusion nature in this 2nd passage 88a falls. Thereby, the fuel cell cel 12 can have gaseous diffusion nature uniform as a whole.
[0044]
[Effect of the Invention] As mentioned above, in the fuel cell concerning this invention, since the water of condensation and produced water of moisture which are contained in fuel gas or oxidant gas are absorbed by the water absorption member, it can prevent certainly that a gas passageway is blockaded with this water. And when a water absorption member swells and dries and the volume changes, the passage cross section of a gas passageway is changed. For this reason, while becoming possible for a gas flow rate to change within a gas passageway, for example, to make said gas flow rate increase, and to raise the gaseous diffusion nature to an electrode catalyst bed, said gas flow rate can be decreased partially and gaseous diffusion nature can be made to equalize on the whole.

[Translation done.]